and maximum EIRP areal spectral density established by the Commission in its Report and Order in CC Docket No. [xx-xx], recognizing that such values may be subsequently modified by Commission order.

(10) Applicants for these bands may elect to operate in the FDMA/TDMA or the CDMA segment of these bands, but not both band segments. Applicants from the initial processing group for these bands who wish to change their proposed access technique must file an amendment within 30 days following the effective date of this rule.

9.1.3 Amend Section 25.202(a)(2) to read as follows:

(2) The following frequencies are available for use by the Mobile and Radiodetermination Satellite Service:

1610-1626.5 MHz: User-to-Satellite Link (primary)
1613.8-1626.5 MHz: Satellite-to-User Link (secondary)
2483.5-2500 MHz: Satellite-to-User Link (primary)

9.1.4 Amend Section 25.202(f) by inserting the following in the introductory paragraph:

(f) Emission limitations. Except as specified in subsections (g) and (h), the mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

9.1.5 Amend Section 25.202 by adding the following new subsection:

(g) Emission limitations in the 1610-1626.5 MHz band. Earth stations. The mean power of emissions shall be attenuated below an

amount equal to the mean output power of the transmitter times the fraction, 3 kHz (or 4 kHz) divided by the authorized bandwidth, in accordance with the following schedule:

(1) In any 3 kHz (or 4 kHz) band, the center frequency of which is removed from the assigned frequency by more than 50 percent plus 1.5 kHz (or 2 kHz) up to and including 150 percent of the authorized bandwidth: 26 dB;

(2) In any 3 kHz (or 4 kHz) band, the center frequency of which is removed from the assigned frequency by more than 150 percent up to and including 250 percent of the authorized bandwidth: 38 dB;

(3) In any 3 kHz (or 4 kHz) band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: 45 dB;

(4) In any event, when an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in paragraphs (g)(1), (2) and (3) of this section.

(5) For the purposes of paragraph (g), the authorized bandwidth is the occupied bandwidth or the necessary bandwidth, whichever is greater.

(6) Upon a showing that the operation of a station will not cause harmful interference to other systems or services, or that the out-of-band PSD is below an interference level coordinated with potentially interfered-with systems, the limits of subsections (g)(1), (2), and (3) shall not apply.

9.1.6 Amend Section 25.202 by redesignating current subsection (h) as (i) and adding the following new subsection:

(h) Emission limitations in the 1613.8-1626.5 MHz and 2483.5-2500 MHz bands, space stations. The mean power of emissions shall be

attenuated below an amount equal to the maximum for any center frequency of the in-band mean power measured in a 3 kHz (or 4 kHz) bandwidth in accordance with the following schedule:

(1) In any 3 kHz (or 4 kHz) band, the center frequency of which is removed from the assigned frequency by more than 50 percent plus 1.5 kHz (or 2.0 kHz) up to and including 150 percent of the authorized bandwidth: 25 dB;

(2) In any 3 kHz (or 4 kHz) band, the center frequency of which is removed from the assigned frequency by more than 150 percent up to and including 300 percent of the authorized bandwidth: 35 dB;

(3) In any 3 kHz (or 4 kHz) band, the center frequency of which is removed from the assigned frequency by more than 300 percent of the authorized bandwidth: 43 dB;

(4) In any event, when an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in paragraphs (h)(1), (2), and (3) of this section.

(5) For the purposes of paragraph (h), the authorized bandwidth is the occupied bandwidth or the necessary bandwidth, whichever is greater.

(6) Upon a showing that the operation of a station will not cause harmful interference to other systems or services, or that the out-of-band PSD is below an interference level coordinated with potentially interfered-with systems, the limits of subsections (h)(1), (2), and (3) shall not apply.

9.2 Recommendations

9.2.1 Recommendation Regarding the Use of the L-Band for Secondary MSS Downlinks

The Commission should authorize secondary MSS downlinks in the L-band from 1613.8-1626.5 MHz in accordance with the decision reached at WARC-92.

9.2.2 Out-of-Band Emissions From Secondary Downlinks Will Not Cause Harmful Interference to MSS Uplinks

So far, only one applicant, Motorola, has proposed to operate secondary downlinks at L-band. It proposes to operate those downlinks using the same frequencies that are assigned to it for its uplinks. Because its uplinks cannot share spectrum with any of the proposed CDMA systems on a co-frequency, co-coverage basis, Motorola has requested exclusive use of the frequencies it is assigned. Thus, most of the time, the only potential interference to other MSS systems from Motorola's secondary downlinks over CONUS will be due to downlink out-of-band emissions. With respect to this general case, none of the MSS applicants claim that out-of-band emissions from Iridium system downlinks will cause harmful interference to their MSS uplinks.

9.2.3 Co-frequency, Co-coverage Emissions From Secondary Downlinks Will Not Cause Harmful Interference to MSS Uplinks

Under some circumstances, the Iridium system downlinks could operate co-coverage, co-frequency with other systems. This situation might occur if the Iridium system operates in other regions of the world on different frequencies than it does in the U.S. In such cases, the Iridium downlinks could potentially interfere with the satellite receivers of other MSS systems. If such interference were to occur, however, it would be occasional and not continuous. The frequency and duration of this interference has not been determined because this requires detailed information which is not available about the orbital and antenna characteristics and service areas

of other systems.

In any event, the amount of interference (in terms of power) into the victim satellite will be extremely small in most cases. It is likely not to be "harmful" because it will be dwarfed by the interference received from the Iridium system's primary uplinks, plus the interference from any other MSS systems operating in these bands. Furthermore, it is unlikely to have a discernible effect on the capacity or performance of other systems.

Finally, and most importantly, to the extent harmful interference would otherwise occur, the Iridium system can avoid such occurrences through several mitigation techniques. Once the real system design of other MSS systems is established and geographic coordination has been initiated, the precise times when potential interference may occur can be calculated. Then, to mitigate sidelobe interference, the Iridium system can program its system to avoid co-frequency operation during times when it is passing by the satellite of another MSS system. Similarly, to avoid trans-horizon interference, the system can shut down the outer beam cells on its downlink and cover areas that would be served by those beams with beams on adjacent Iridium satellites. The beams on adjacent satellites will not cause trans-horizon interference to the victim satellite because they will be arriving from different angles. Through these and other interference-mitigating techniques, potential downlink interference can be avoided.

9.2.4 Operating a Downlink at 2483.5-2500 MHz Would Not Permit the Iridium System to Achieve its Business Objectives

The Iridium system cannot use the primary MSS downlink band (2483.5-2500 MHz) and achieve its business and service objectives. Motorola's business plan calls for highly reliable, ubiquitous service to handheld units anywhere in the world. Consequently, the system has been designed with high link margins to overcome most shadowed and fading conditions.

There are at least two fundamental obstacles to achieving this objective using S-band downlinks. First, there is an effective regulatory

limit on the amount of power that an S-band downlink can place on the earth (the power flux density, or pfd) to protect terrestrial users in the band. This value is different for different elevation angles, but the highest permitted pfd without coordination (which occurs for the 25°-90° inclination angle) is -142 dBW/m2/4kHz. (See ITU RR 2566) This is approximately 20 dB less than the minimum level needed to achieve the quality of service desired for the Iridium system. Moreover, due to the number of terrestrial systems in the band, it would be impossible to coordinate these downlinks over the entire world.

The second fundamental obstacle to using the S-band is that the Industrial, Scientific and Medical (ISM) applications operating in the 2400-2500 MHz band will cause very large levels of interference to any MSS downlinks operating in this band. This interference is due, in particular, to microwave ovens, of which there are over 80 million in the U.S. alone. A recent NTIA study measured the level of this interference in one city with a population of about 90,000 people. From these measurements, it is easy to demonstrate that the level of background interference in metropolitan areas from ISM devices exceeds by almost 50 dB the noise floor of MSS receivers. While such high levels of ambient noise may be acceptable to MSS operators who plan to serve urban areas through local cellular systems (using dual mode handsets), it would prevent the Iridium system from achieving its business objectives which include service to customers traveling in such locations.

MSSAC 41.8
Appendix 1
(Final)

MSSAC ABOVE 1 GHz ADVISORY COMMITTEE

INFORMAL WORKING GROUP 1

Consolidated List of Persons Attending

Bill Ames	Qualcomm, Inc. (LQSS)
D. Archer	Ellipsat Australia
Melvin Barmat	Jansky/Barmat Telecom (Motorola)
Richard Barnett	Telecomm Strategies (TRW)
Bary Bertiger	Motorola, Inc.
Donna L. Bethea	Federal Communications Commission
Jeffrey Binckes	Comsat Mobile Comm.
William M. Borman	Motorola, Inc.
John W. Brosius	Ellipsat Corporation
Steve Carter	Qualcomm, Inc. (LQSS)
Dan Cassidy	Sedgwick Aerospace
Steve Clark	Motorola, Inc.
Mary Dent	Goldberg Godles Wiener & Wright (European Community)
Dennis Diekelman	Motorola, Inc.
Dan DiFonzo	Planar Communications (Motorola)
Doug Dwyre	Loral Qualcomm Satellite Services
Bill English	Iridium, Inc.
James G. Ennis	Fletcher Heald & Hildreth (Motorola)
Bob Filep	Communications 21 Corp.
Ted Fine	Celsat Inc.
Albert H. Frazier	Celsat Inc.
Bob Frazier	Federal Aviation Administration
Dale Gallimore	Loral Qualcomm Satellite Services
John Gilsenan (Coordinator, IWG-1)	State Department
Klein Gilhousen	Qualcomm, Inc. (LQSS)
Steve Goldberg	Northwestern University Law School
John Hatlelid	Motorola, Inc.
Gerald Helman	Ellipsat Corporation
William Horne	STel/NASA/State
Kevin Kelley	Qualcomm, Inc. (LQSS)
Mike Kennedy	Motorola, Inc.

Jim King	Constellation
Tim Klandrud	Motorola, Inc.
John Knudsen	Motorola Satellite Communications
Len Kolsky	Motorola, Inc.
Barry Lambergman	Fletcher Heald & Hildreth (Motorola)
Michael Lehmkuhl	Goldberg Godles Wiener & Wright (European Community)
Raymond J. Leopold	Motorola Satellite Communications
Ron Lepkowski	Constellation Communications
Norman Leventhal	Leventhal Senter & Lerman (TRW)
Lon Levin	American Mobile Satellite Corp.
Kostas Liopiros	KJL Associates
Ming Louie	Loral Qualcomm Satellite Services
Chris McCarter	Communications Daily/Satellite Week
John Major	Motorola, Inc.
Philip Malet	Steptoe & Johnson (Motorola)
Jack Mallinckrodt	Celsat Inc.
Alfred Mamlet	Steptoe & Johnson (Motorola)
Michael Marcus	Federal Communications Commission
Robert Mazer	Nixon Hargrave Devans & Doyle (Constellation)
Reuven Meidan	Motorola, Inc.
Pantelis Michalopoulos	Steptoe & Johnson (Motorola)
Edward F. Miller (Facilitator)	NASA
Peter Monsen	PM Associates (Motorola)
Paul Monte	Loral Qualcomm Satellite Services
L. Warren Morrison	Celsat, Inc.
Gerald M. Munson	Motorola, Inc.
Robert A. Nelson	W.L. Pritchard & Co. Inc. (LQSS)
Harry Ng	Federal Communications Commission
Sam Nguyen	Comsat
Keith Olds	Motorola, Inc.
Dave Otten	Celsat, Inc.
Cahit Ozbay	W. L. Pritchard & Co. (LQSS)
B. Pattan	Federal Communications Commission
Ken Peterson	Motorola, Inc.
Raymond L. Pickholtz	The George Washington University (Consultant, Motorola)
Wilbur Pritchard	W. L. Pritchard & Co. (LQSS)
Jay Ramasastry	Qualcomm, Inc. (LQSS)
Brian K. Ramsay	NTIA/OSM

Ed Reinhart (Coordinator, IWG-2)	Consultant NASA
Roger Rusch	TRW Inc.
Linda Sadler	Rockwell Int'l Corp.
Linda Smith	Crowell & Moring (LQSS)
Dave Sterling	Motorola Washington Systems Office
Tom Sullivan	Atlantic Research Corp. (AMSC)
Robert Summers	Defense Systems, Inc. (Constellation)
Leslie A. Taylor	Leslie Taylor Associates (LQSS)
Victor Toth	Law Offices of Victor J. Toth (Celsat)
Tom Trimmer	Army/DOD
Thomas S. Tycz	Federal Communications Commission
Greg Vatt	Motorola Satellite Communications
Branimir Vojcic	The George Washington University (Consultant, Motorola)
William D. Wallace	Crowell & Moring (LQSS)
Michael K. Ward	American Mobile Satellite Corp.
R. E. Weiblen	Celsat, Inc.
Bob Wiedeman	Loral Qualcomm Satellite Service
John Windolph	Iridium, Inc.
Eric Wiswell	TRW Inc.

INFORMAL WORKING GROUP 1

DRAFTING GROUPS A AND B

Consolidated List of Persons Attending

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D. Archer	Ellipsat Australia
Melvin Barmat	Jansky/Barmat Telecom (Motorola)
Richard Barnett	Telecomm Strategies (TRW)
Donna L. Bethea	Federal Communications Commission
Jeffrey Binckes	Comsat Mobile Comm.
William M. Borman (Chair, DG-B)	Motorola, Inc.
John W. Brosius	Ellipsat Corporation
Steve Carter	Qualcomm, Inc. (LQSS)
Steve Clark	Motorola, Inc.

James G. Ennis	Fletcher Heald & Hildreth (Motorola)
Dale Gallimore	Loral Qualcomm Satellite Services
John Gilsenan (Coordinator, IWG-1)	State Department
John Hatlelid	Motorola, Inc.
Gerald Helman	Ellipsat Corporation
John Knudsen	Motorola Satellite Communications
Barry Lambergman	Fletcher Heald & Hildreth (Motorola)
Raymond J. Leopold	Motorola Satellite Communications
Ron Lepkowski	Constellation Communications
Norman Leventhal	Leventhal Senter & Lerman (TRW)
Ming Louie	Loral Qualcomm Satellite Services
Philip Malet	Steptoe & Johnson (Motorola)
Jack Mallinckrodt	Celsat Inc.
Alfred Mamlet	Steptoe & Johnson (Motorola)
Michael Marcus	Federal Communications Commission
Robert Mazer	Nixon Hargrave Devans & Doyle (Constellation)
Pantelis Michalopoulos	Steptoe & Johnson (Motorola)
Peter Monsen	PM Associates (Motorola)
Paul Monte	Loral Qualcomm Satellite Services
L. Warren Morrison	Celsat, Inc.
Gerald M. Munson	Motorola, Inc.
Robert A. Nelson	W.L. Pritchard & Co. Inc. (LQSS)
Harry Ng	Federal Communications Commission
Sam Nguyen	Comsat
B. Pattan	Federal Communications Commission
Jay Ramasastry (Chair, DG-A)	Qualcomm, Inc. (LQSS)
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Linda K. Smith	Crowell & Moring (LQSS)
Tom Sullivan	Atlantic Research Corp. (AMSC)
Victor Toth	Law Offices of Victor J. Toth (Celsat)
Thomas S. Tycz	Federal Communications Commission
Greg Vatt	Motorola Satellite Communications
William D. Wallace	Crowell & Moring (LQSS)
Michael K. Ward	American Mobile Satellite Corp.
R. E. Weiblen	Celsat, Inc.

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7 April 1993

Report of Informal Working Group 2 (Inter-service Sharing Issues)

to the

MSS above 1 GHz Negotiated Rulemaking Committee

Edward E. Reinhart

Coordinator, IWG 2

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REPORT OF INFORMAL WORKING GROUP 2 (INTER-SERVICE SHARING ISSUES) TO THE MSS ABOVE 1 GHz NEGOTIATED RULEMAKING COMMITTEE

Edward E. Reinhart, Coordinator IWG2

1. INTRODUCTION

1.1 Work Program

The work program of Informal Working Group 2 (IWG 2) was defined in the introduction and in parts B and C of the full-Committee work program (see Doc MSSAC-4 (Rev. 1)) as follows:

- Develop recommendations for FCC Rules in 47 C.F.R. Part 25 that address the technical aspects related to the selection and authorization of applicants to provide U.S. mobile satellite service (MSS) and radiodetermination satellite service (RDSS) in the 1610-1626.5 MHz and 2483.5-2500 MHz frequency bands, and to the shared use of those bands by authorized entities. Recommend any other technical modifications or new rules to the FCC rules as may be necessary to authorize MSS/RDSS systems in these bands.

- Recommend technical means for the domestic and international coordination of MSS/RDSS systems in these bands with the other services to which these bands are allocated, including:

  (1) Aeronautical radionavigation, including systems operating under the provisions of ITU RR 732 and ITU RR 731X (1610-1626.5 MHz band only);

  (2) Radio astronomy, see ITU RR 733 A and ITU RR 734 (1610.6-1613.8 MHz band only);

  (3) Fixed and mobile.

- Recommend operating conditions and criteria necessary to protect primary services other than MSS in the 1613.8-1626.5 MHz band from harmful interference from secondary MSS space-to-Earth links in the 1613.8-1626.5 MHz band, as required by 47 C.F.R. § 2.104 (d) (4).

In summary, IWG 2 was to recommend technical means for inter-service frequency sharing, i.e., sharing between MSS/RDSS systems and systems in other services with primary allocations either in the cited MSS/RDSS bands, or close enough to them to make mutual interference a possibility.

IWG 2 interpreted this mandate to include interference protection both to and from MSS/RDSS systems and a responsibility to make periodic reports of its work to IWG 1. It also agreed that, as a minor extension to scope of the tasks assigned by the Committee work program, it would consider the problem of interference between secondary MSS downlinks in the 1613.8-1626.5 MHz band and other secondary services in this band.

1.2 Interservice Sharing Scenarios Considered

Based on the international allocation table as revised at WARC-92 and presented in Doc IWG2-2, there are a large number of interservice interference possibilities. These are tabulated in Table 1-1 for reference both in describing how the work of IWG2 was divided among drafting groups and for describing the results of that work.

Referring to Table 1-1, note that sharing cases in which the other services are the victims of interference from MSS/RDSS systems are listed in part A of the table; those where MSS/RDSS stations are the victims are listed in part B. In each part, cases involving the same victim service and frequency band are grouped together with "in-band" interference cases (where the interfering service lies within the same band as the victim service) listed before the "out-of-band" cases. In part B, each case except 16 corresponds to interference in the reverse direction from one of the cases in part A. This correspondence is indicated by adding the letter R to the case number from part A.

1.3 Working Group Structure and Assignment of Tasks

At its early meetings, reports on system characteristics and the results of technical sharing analyses were presented to and discussed in detail by the working group as a whole. However, as the inputs needed for definitive work on a related group of sharing issues became available, a drafting group was created to develop recommendations on those issues. Three such drafting groups were formed:

- IWG2 Drafting Group A (DG2A), chaired by Jack Wengryniuk of Comsat Labs, was given the responsibility for all sharing issues involving protection of the Radioastronomy Service (RAS)--i.e., interference cases 1, 2, 3, and 4 in Table 1-1.

- IWG2 Drafting Group B (DG2B), chaired by Sam Nguyen of Comsat Mobile, dealt with all issues involving sharing with the Aeronautical Radionavigation Service (ARNS) (including airborne electronic aids to air navigation and any directly associated ground-based or satellite-borne facilities as specified in RR 732)--i.e., interference cases 5, 6, 7, 8, and 5R.

- IWG2 Drafting Group C (DG2C), chaired by Bill Pritchard, consultant to LQSS, and Bob Weiblen, consultant to CELSAT, was assigned the remaining 15 interference cases, involving interference to and from the fixed service (FS), mobile service (MS), radiolocation service (RLS), broadcasting-satellite service and from Industrial, Scientific and Medical (ISM) applications.

1.4 Working Group Meetings and Participation

After a brief organizational meeting on 6 January 1993, IWG2 met nine times with an average participation of 35 persons. Meetings were held on 15 and 26 January, 8, 16, and 25 February, and 5, 15, 23, and 30 March. The list of participants in the work of IWG2 and each of its drafting groups is given in Appendix A.

1.5 Documentation

Each of the documentary inputs to IWG2, as well as summary reports on the highlights of each meeting and reports from the drafting groups and from the group as a whole was assigned a number of the form "Doc IWG2-X." A total of 82 such documents were produced. The date, source, subject, and length of each document is listed in Appendix B.

TABLE 1-1. IDENTIFICATION OF POSSIBLE INTER-SERVICE SHARING PROBLEMS

Case	Interference to Service[6]	Band (MHz)	Interference From Service[6]	Band (MHz)
A. Interference to other services from MSS/RDSS				
1	RAS	1610.6-1613.8	MSS/RDSS↑	1610.6-1613.8
2	RAS	1610.6-1613.8	MSS/RDSS↑	<1610.6&>1613.8
3	RAS	1610.6-1613.8	Sec MSS↓	1613.8-1626.5
4	RAS	4990 -5000	MSS/RDSS↓	2483.5-2500
5	ARNS[1]	1610 -1626.5	MSS/RDSS↑	1610 -1626.5
6	ARNS[1]	1610 -1626.5	Sec MSS↓	1613.8-1626.5
7	ARNS/RNSS↓	1559 -1610	MSS/RDSS↑	1610 -1626.5
8	ARNS/RNSS↓	1559 -1610	Sec MSS↓	1613.8-1626.5
9	FS[2]	1610 -1626.5	MSS/RDSS↑	1610 -1626.5
10	Sec FS[3]	1610 -1626.5	Sec MSS↓	1613.8-1626.5
11	FS & MS	2483.5-2500	MSS/RDSS↓	2483.5-2500
12	FS & MS	2450 -2483.5	MSS/RDSS↓	2483.5-2500
13	FS[4] & MS[5]	2500 -2690	MSS/RDSS↓	2483.5-2500
14	BSS & FSS	2500 -2690	MSS/RDSS↓	2483.5-2500
15	RLS	2483.5-2500	MSS/RDSS↓	2483.5-2500
B. Interference to MSS/RDSS from other services				
5R	MSS/RDSS↑	1610 -1626.5	ARNS[1]	1610 -1626.5
9R	MSS/RDSS↑	1610 -1626.5	FS[2]	1610 -1626.5
10R	Sec MSS↓	1613.8-1626.5	Sec FS[3]	1610 -1626.5
11R	MSS/RDSS↓	2483.5-2500	FS & MS	2483.5-2500
12R	MSS/RDSS↓	2483.5-2500	FS & MS	2450 -2483.5
13R	MSS/RDSS↓	2483.5-2500	FS & MS[5]	2500 -2690
14R	MSS/RDSS↓	2483.5-2500	BSS & FSS	2500 -2690
15R	MSS/RDSS↓	2483.5-2500	RLS	2483.5-2500
16	MSS/RDSS↓	2483.5-2500	ISM	2400 -2500

Notes:

[1]Including airborne electronic aids to air navigation and any directly associated ground-based or satellite-borne facilities per RR 732.

[2]In 20 countries as listed in RR 730 (MOD WARC-92).

[3]In 29 countries as listed in RR 727.

[4]MMDS, ITFS, and OFS in the U.S.

[5]Except AMS.

[6]Abbreviations:

AMS	Aeronautical mobile service	MSS	Mobile-satellite service
ARNS	Aeronautical radionavigation service	OFS	Operational fixed service
BSS	Broadcasting-satellite service	RAS	Radioastronomy service
FS	Fixed service	RDSS	Radiodetermination-satellite service
FSS	Fixed-satellite service	RLS	Radiolocation service
ISM	Industrial, scientific, & medical	RNSS	Radionavigation-satellite service
ITFS	Instructional television fixed service	Sec	Secondary allocation
MMDS	Microwave multipoint distribution service	↑	Uplink
MS	Mobile service	↓	Downlink

Summaries of meeting highlights variously prepared by W. Borman, S. Clark, S. Malet, A. Mamlet, M. Mitchell, and E. Reinhart are given in Documents IWG2-10, 21, 31, 41, 51, 64, 73, 79, and 82.

Liaison reports to IWG 1 were prepared by the drafting group chairmen and are contained in Documents IWG2-52 (=IWG1-60), 53 (=IWG1-61), and 65 (=IWG1-65).

Progress reports to the full committee are presented in Documents IWG2-22, 46 (=MSSAC 42.1), 67 (=MSSAC 42.2), and 78 (=MSSAC 42.3).

The reports of the drafting groups to IWG2 are as follows:

- DG2A: IWG2-61 (Rev. 4) = MSSAC 42.4
- DG2B: IWG2-74 (Rev. 3) = MSSAC 42.5
- DG2C: IWG2-75 (Rev. 4) = MSSAC 42.6 (Rev. 1)

1.6 Structure of This Report

The specific problems associated with each of the interference cases listed in Table 1-1, the approaches to dealing with them, and the comparative analyses of these approaches are summarized in Sections 2, 3, and 4 for the cases considered by Drafting Groups A (RAS), B (ARNS), and C (FS, MS, BSS, RLS, and ISM), respectively. In each case, the relevant sections of the Drafting Group reports are cited to facilitate access to the detailed descriptions presented there.

The conclusions and recommendations of the working groups are then presented without abridgement on a case-by-case basis in Section 5. In each case, the section of the Drafting Group reports from which the conclusions and recommendations were drawn is indicated. The final subsection of Section 5 comments on the significance of the conclusions and recommendations of IWG 2.

The reports of drafting groups 2A, 2B, and 2C to IWG 2 are included for reference as Attachments to this report of IWG 2 to the Committee:

Attachment A = Doc MSSAC 42.4 = Doc IWG2-61 (Rev. 4), Report of Drafting Group 2A
Attachment B = Doc MSSAC 42.5 = Doc IWG2-74 (Rev. 3), Report of Drafting Group 2B
Attachment C = Doc MSSAC 42.6 = Doc IWG2-75 (Rev. 4), Report of Drafting Group 2C

2. PROTECTION OF THE RADIO ASTRONOMY SERVICE

2.1 Characteristics of the Radio Astronomy Service in the Relevant Frequency Allocations (DG2A Report §1.1)

The radio astronomy service (RAS) is defined in RR 55 as "a service involving the use of radio astronomy" which, in turn, is defined in RR 14 as "astronomy based on the reception of radio waves of cosmic origin." Since radio astronomy involves only radio reception, it cannot interfere with other services to which the same frequency band may be allocated, and so "sharing" with the RAS consists of protecting it against unacceptable interference from the transmitters in other services.

Protection of the RAS is important because a substantial portion of what has been learned about the universe in the last 60 years is based on observations by radio astronomers of the line and continuum radiation spectra of cosmic radio sources. Such protection can be difficult to achieve because cosmic radiation emissions are similar to random noise in nature and have extremely low power flux levels at the Earth. On the other hand, radio astronomy observatories are usually located

in remote areas well shielded from interference by terrain features, and observations in a frequency band are not always continuous.

The band 1610.6-1613.8 MHz is allocated to the RAS on a worldwide primary basis and is shared with primary allocations for MSS/RDSS uplinks and the aeronautical radionavigation service (ARNS). It is used at RA observatories to observe the spectral line of the hydroxyl molecule near 1612 MHz, which is considered by radio astronomers to be among the most important line below 275 GHz. The upper and lower band limits correspond to the maximum expected "blue shift" and "red shift" of this line due to the relative motion of the galactic sources. Observations include the use of very long baseline arrays (VLBA) to determine the angular size of the sources.

The band 4990-5000 MHz is allocated to the RAS worldwide on a primary basis as one of several bands used for the observation of continuum radiation. It is of interest here because it embraces the second harmonics of MSS/RDSS downlink transmissions in the 2483.5-2500 MHz band.

2.2 Existing Regulatory Protection of the RAS (DG2A Report §1.2)

A number of paragraphs of the radio regulations and footnotes to the allocation table apply to the protection of the RAS. Specific harmful interference limits are discussed in CCIR Recommendation 224-7.

2.3 Existing Interference to the RAS (DG2A Report §2.1)

In considering how to protect the RAS from MSS/RDSS interference at L band, it should be noted that the RAS already suffers severe interference from the Russian GLONASS system, a worldwide satellite system for aeronautical radionavigation operating in the 1610-1616 MHz band under RR 732. Indeed, it is estimated that more than 90% of current RA measurements in the 1610.6-1613.8 MHz band are rendered unusable by interference when the GLONASS system is operating.

The RA community is conducting a series of meetings with the Russian administration to discuss possible ways to redesign the GLONASS system to reduce its interference to the RAS. This effort is relevant to the MSS because modifications to GLONASS that protect the RAS can also reduce the vulnerability of GLONASS to interference from the MSS.

2.4 Interference Protection Required by the RAS (DG2A Report §2.3) and Sites To Be Protected (DG2A Report §3)

The recommended protection limits for the RAS are specified in CCIR Report 224 as -238 dB(W/m^{2}Hz) in the 1610.6-1613.8 MHz band and -241 dB(W/m^{2}Hz) in the 4990-5000 MHz band. Observatories at which VLBA measurements are being made in the former band require somewhat less protection.

The locations and heights above mean sea level of the 16 radio astronomy sites in the U.S. (including Puerto Rico) that conduct L-band observations are listed in Table 3-1 of the DG2A Report. Of these, only five need to be protected to the -238 dB(W/m^{2}Hz) level; the remaining are VLBA sites. Outside the U.S., there are 17 sites equipped to observe at L band; they are listed in Table 3-2 of the DG2A Report.

Radio astronomy sites need to be protected from MSS/RDSS transmissions at L band only while conducting observations in this band. It is estimated that such observations will take place not more than 25% of the time. The RA community is willing to establish an advance notification procedure of observation schedules in the U.S. so that MSS/RDSS system operators will know when interference protection is needed at each site.